sion into numbers, and cubing it, we find the value of M to be 1·0027259, which agrees very closely with the value found by Sir George Airy by comparing the constant terms on the two sides of his equation (10).

The other two ways of finding M proposed by Sir George in p. 76 of his Theory, viz. by comparing the quantities on the two sides of the equations (10) and (12), corresponding to the arguments 2 and 301 respectively, are not satisfactory, as the results will be affected by errors in the theoretical determinations of the mean motions of the Moon's perigee and node respectively.

The multiplier M, representing the sum of the masses of the Earth and Moon, must be employed wherever the mutual attraction of these two bodies comes in question. In Sir George Airy's note at p. 254 of the March number of the *Monthly Notices*, he calls M the coefficient of a *solar* term, but this is plainly a mistake. I should mention that I have already communicated the substance of this paper to Sir George Airy himself.

The Positions for 1750·0 *and Proper Motions of* 154 *Stars south of* −29° *declination deduced from a revision of Powalky's Reduction of the Star Places of Lacaille's Astronomiæ Fundamenta.* By A. M. W. Downing, M.A.

In the report of the Superintendent of the U.S. Coast and Geodetic Survey for the year ending June 1882, the late Dr. C. R. Powalky published "a new reduction of Lacaille's observations, made at the Cape of Good Hope and at Paris between 1749 and 1757, and given in his *Astronomiæ Fundamenta*, together with a comparison of the results with the Bradley-Bessel *Fundamenta*; also a catalogue of the places of 150 stars south of declination −30°, for the epochs 1750 and 1830." Powalky's catalogue thus depends on the star places of Bessel's *Fundamenta*, that is to say, the assumed right ascensions of the stars used for determination of clock error are those of the *Tabulæ Regiomontanæ* or of the *Fundamenta*, and systematic corrections to Lacaille's declinations have been determined by comparing them with the same authorities. It is the object of the present paper to deduce the necessary corrections to Powalky's places of the stars observed at the Cape, so as to make them depend on Auwers' re-reduction of Bradley, and to determine the proper motions resulting from a comparison of these corrected places with the mean for the epoch 1875 of Stone's Cape Catalogue, and Gould's Argentine General Catalogue. The various processes of reduction are not very clearly explained by Powalky, and on my writing to Professor Peters, of Clinton (who examined and reported on the paper), to ask if he could supply me with any further information, he had the great kindness to cause a search

for Powalky's MSS. to be made, a search which unfortunately proved unsuccessful. It was necessary therefore to go through some of the computations in order to ascertain how the star places used in the reductions had been deduced from Bessel's places, and as the result of this examination it appeared that the apparent places of the stars contained in the *Tabulæ Regiomontanæ*, which were used for clock error, were taken without alteration from that work (with the exception of *Sirius*, the apparent places of which were corrected for orbital motion as determined by Auwers), and that the apparent places of stars taken from the *Fundamenta* were brought back from 1755 with the annual precessions of the *Fundamenta*, without proper motion, but with "star corrections" computed from the modern elements. It has been assumed, therefore, that Powalky's "star corrections" are correct throughout (he states that the "day constants" for 1750–1757 were taken from Struve's *Tabulæ Quantitatum Besselianarum pro annis* 1750–1840), and that in bringing back the places from the *Fundamenta* he has used the precessions of the *Fundamenta*, omitting proper motions. In revising the assumed right ascensions of "clock" stars (which as well as the southern stars were observed by Lacaille at the Cape by the method of equal altitudes, using an iron 3-foot quadrant in connection with a $3\frac{1}{2}$-foot telescope and a clock of Le Roy), it was therefore necessary to compute "star corrections" for *Sirius* and for the other *Tabulæ Regiomontanæ* stars for each day on which they were observed, using the *Tabulæ Quantitatum Besselianarum pro annis* 1750–1840, and Stone's "Tables for Constants of Star Reductions" adapted to the epoch. The proper motions were, of course, taken from Auwers' Bradley, and the places of *Sirius* and *Procyon* further corrected for orbital motion in accordance with the elements determined by the same astronomer (*Publ. Ast. Ges.* No. vii., and *Ast. Nach.* No. 1373). The apparent places of the *Fundamenta* stars as given by Powalky were corrected for proper motion, difference between Bessel's and Struve's precessions, and difference between Bessel's and Auwers' reduction of Bradley. The clock errors deduced from observations of the Sun, for which the Hansen-Olufsen Solar Tables were used, have been retained unaltered. From the clock errors thus corrected the revised right ascensions of the southern stars were determined. With but two or three exceptions these were observed on one day only, and it is difficult to form an estimate as to the probable errors of the positions; from forty observations of *Sirius*, however, made on days when there was a fair independent determination of clock error, the mean right ascension for 1751·0 is $6^h\ 34^m\ 10^s{\cdot}626$, with probable error of a single determination $\pm 0^s{\cdot}182$, which should not differ much from the probable error of a Catalogue place. The maximum correction applicable to the right ascension of a southern star as reduced by Powalky is $0^s{\cdot}15$.

Observations of zenith distance were made by Lacaille at the Cape with

I. Sextant with 6-foot telescope,
II Sextant with 5-foot telescope,
III. Sector,

some details of the construction of which are given by Powalky, pp. 470, 471.

For the latitude of Lacaille's observatory at the Cape, Powalky's value ($-33° 55' 15''\cdot 8$) has been used. It is stated on p. 471 that the refractions have been computed from the Pulkowa tables, with "corrections for mean temperature (from Dove's tables) and barometer."

Corrections to the *Fundamenta* declinations, as given by Powalky, of the Bradley stars observed by Lacaille at the Cape have been determined in the same way as for the right ascensions, and corrections to Lacaille's three series of declinations, of the form $x \sin \delta + y \cos \delta$, deduced by the method of least squares from the comparison of Lacaille's places of these stars with the standard places, in combination with the observations of circumpolar stars observed above and below the pole. The three series of corrections, compared with the corresponding ones deduced by Powalky, are:

I.	α.	$+6''\cdot 9 \sin \delta$	$+3''\cdot 4 \cos \delta$
	β.	$+6\cdot 04 \sin \delta$	$+3\cdot 05 \cos \delta$
II.	α.	$+8\cdot 33 \sin \delta$	$+4\cdot 45 \cos \delta$
	β.	$+5\cdot 79 \sin \delta$	$+4\cdot 43 \cos \delta$
III.	α.	$+20\cdot 5 \sin \delta$	$+11\cdot 5 \cos \delta$
	β.	$+18\cdot 29 \sin \delta$	$+10\cdot 91 \cos \delta$

The figures I. II. and III. refer to the three series of declinations observed by Lacaille with his different instruments described above, and α and β are the corrections deduced by Powalky and in the present investigation respectively. The differences found between these may to some extent be due to difference of treatment. In the present investigation, for convenience of computation, the stars have been combined in groups, the correction deduced from each star place being given equal weight, independently of the number of observations on which it depends, and in I. and II. the groups have been given weights equal to the number of stars included in each, whilst in III., as the distribution of groups is unfavourable, each group has been given equal weight. It is not quite clear what course has been followed by Powalky in this part of the work. The application of these corrections gives the final catalogue declinations, which in general depend on observations made with one instrument only, but in those cases (there are ten of them) in which more

than one instrument has been used, the agreement is satisfactory, the average discordance being $2''\cdot 8$, and the maximum discordance $5''\cdot 7$. In combining observations made with different instruments, half weight has been given to II. From Powalky's paper, p. 475, where he gives the separate re-reduced observations of zenith distance of *α Virginis*, it appears that the probable error of a single declination observed at the Cape with the sextant (principal telescope) is $\pm 3''\cdot 2$, and with the sector is $\pm 1''\cdot 4$; the corrections of the form $x \sin \delta + y \cos \delta$ are much more satisfactorily determined for the former than for the latter, and it appeared preferable, therefore, to give the results derived from these two instruments equal weight when combining them. Powalky gives no data for determining the probable error of a declination observed with the smaller telescope on the sextant. The declinations in the Catalogue depend generally on five or six observations.

For further details of the observations and their reduction the reader is referred to Powalky's paper.

A catalogue of the places of 154 stars south of declination $-29°$ for the epoch 1750·0 having been thus formed, precessions for that epoch were computed by the help of Stone's "Tables for Constants of Star Reductions" before mentioned. With these precessions and their secular variations, deduced from comparing them with the precessions given in the Cape Catalogue for 1850, the places of the stars were brought up to 1812·5, the middle epoch between 1750·0 and 1875·0, and the precessions again computed for 1812·5. We thus have precessions for three equi-distant epochs, 1750·0, 1812·5 and 1875·0 (the latter being taken from Gould's Catalogue), and therefore the mean annual precession for the interval 1750–1875

$$= \tfrac{1}{6}(p_1 + 4p_2 + p_3),$$

which is accurate to the fourth power of the time.

By means of the mean annual precessions computed from this formula, Lacaille's places have been brought up to 1875·0, and compared with the mean of Stone's Cape Catalogue (brought back from 1880 with the proper motions of that Catalogue), and Gould's Argentine General Catalogue, and thus the proper motions given in the following catalogue have been determined.

The same method has been followed for all the stars contained in the catalogue except *τ Octantis* (Dec. 1750=88° 50′), for which the rigorous trigonometrical formulæ have been used.

Where a star in the catalogue is designated by Lacaille's number, the reference is to the number in Lacaille's Zone Catalogue of 9766 stars. The approximate places of stars observed in one element only have been taken from the same catalogue.

In the case of *α Centauri* the common proper motion has been found by comparing the mean of the places of the two components for 1750, brought up to 1875, with the mean of their places for 1875.

Star's Name.	Mean R.A. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in R.A.	Mean Dec. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in Dec.
	h m s		s	s	s	° ′ ″		″	″	″
ζ Toucani	0 6 52·12	51·77	+2·9783	+2·9406	+0·268	−66 20 45·2	52·0	+20·057	+20·041	+1·18
β Hydri	0 12 11·02	51·73	2·7152	2·6551	+0·709	78 39 50·2	51·9	20·037	20·017	+0·31
α Phœnicis	0 13 51·60	51·77	2·9926	2·9776	+0·018	43 39 57·6	51·8	20·029	20·005	−0·40
λ Phœnicis	0 19 17·30	52·86	2·9349	2·9168	+0·008	50 11 22·2	52·1	19·995	19·965	+0·03
β[1] Toucani	0 19 58·25	51·77	2·8275	2·7972	−0·002	64 20 21·2	51·6	19·989	19·960	−0·02
ξ Phœnicis	0 30 19	...	...	...	...	57 52 57·8	52·2	19·889	19·850	+0·12
η Phœnicis	0 32 1·66	51·85	2·7618	2·7402	−0·003	58 49 30	...	...	...	...
λ Hydri	0 39 50·39	51·77	2·1215	2·0967	+0·017	76 17 16·8	51·9	19·763	19·724	−0·04
β Phœnicis	0 54 52·31	51·70	2·7167	2·7047	−0·003	48 3 48·0	51·8	19·493	19·428	+0·01
ζ Phœnicis	0 57 48	...	...	...	...	56 35 18·7	51·9	19·430	19·366	+0·05
γ Phœnicis	1 17 28·18	51·70	2·6322	2·6239	0·000	44 36 27·2	51·7	18·930	18·844	−0·17
δ Phœnicis	1 20 47·92	51·70	2·5118	2·5025	+0·016	50 22 48·2	51·7	18·831	18·746	+0·19
α Eridani	1 28 22·40	51·73	2·2484	2·2397	+0·008	58 30 52·9	52·2	18·592	18·509	−0·02
χ Eridani	1 46 12·98	52·86	2·2802	2·2744	+0·067	52 51 46·2	52·3	17·949	17·851	+0·34
α Hydri	1 50 52·93	51·77	1·8594	1·8576	+0·038	62 47 36·2	52·3	17·762	17·678	+0·03
δ Hydri	2 17 23·53	51·75	1·0183	1·0375	−0·012	69 48 5·7	52·0	16·567	16·509	−0·01
κ Hydri	2 21 38·79	51·85	+0·2208	+0·2732	−0·037	74 46 46·0	52·0	16·354	16·336	0·00
μ Hydri	2 37 47·14	51·85	−1·8477	−1·6640	+0·029	80 11 38·9	52·0	15·495	15·592	−0·05
θ Eridani	2 48 47·01	51·77	+2·2799	+2·2796	−0·006	41 19 9·3	51·9	14·866	14·721	+0·05
12 Eridani	3 1 27·42	51·77	+2·5205	+2·5211	+0·025	−29 59 13·1	52·0	+14·098	+13·929	+0·66

Star's Name.	Mean R.A. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in R.A.	Mean Dec. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in Dec.
	h m s		s	s	s	° ′ ″		″	″	″
Lacaille 1244	3 39 22·69	51·92	+2·2029	+2·2045	+0·007	−38 23 58·4	52·0	+11·553	+11·385	+0·03
Lacaille 1253	3 41 10·44	51·94	+0·6456	+0·6647	+0·039	65 35 57·8	52·0	11·425	11·373	+0·12
γ Hydri	3 51 26·85	51·85	−1·1572	−1·0872	+0·008	74 59 54·4	52·0	10·674	10·757	+0·09
υ^4 Eridani	4 8 27·c3	51·85	+2·2595	+2·2615	+0·001	34 25 26·1	52·0	9·385	9·200	+0·01
α Reticuli	4 11 16·39	51·85	0·7239	0·7378	+0·004	63 6 14·1	52·0	9·167	9·105	+0·02
δ Cœli	4 23 11·95	51·92	1·8280	1·8311	−0·004	45 30 11·6	52·0	8·225	8·071	0·00
υ^7 Eridani	4 25 50	...	...	...	...	31 5 25·8	52·0	8·015	7·817	−0·01
α Doradûs	4 28 36 83	51·82	+1·2711	+1·2774	+0·010	55 34 29·2	52·1	7·790	7 681	+0·11
δ Mensæ	4 35 43·74	51·92	−4·6121	−4·4399	+0·005	80 46 13·8	52·0	7·213	7·594	+0·07
α Columbæ	5 30 36·35	51·94	+2·1674	+2·1690	−0·001	34 13 24·0	52.5	2·567	2·369	−0·02
β Doradûs	5 31 29·47	51·97	0·5027	0·5078	−0·003	62 39 29·6	52·1	2 490	2·443	+0·05
β Columbæ	5 42 9·68	51·92	+2·1051	+2·1068	+0·001	35 52 42·7	52·5	+1·560	+1·367	−0·06
ν Doradûs	6 10 21·74	51·98	−0·3732	−0·3742	−0·020	68 47 14·7	52·1	−0·907	−0·874	+0·04
ζ Canis Majoris	6 10 43	...	...	...	...	29 58 11·5	52·2	0·938	1·145	+0·01
3 Canis Majoris	6 12 59·31	51·94	+2·1916	+2·1929	−0·006	33 19 37·4	52·1	1·137	1·335	−0·03
α Argûs	6 18 24·34	51·74	1·3277	1·3285	+0·002	52 34 10·3	52·2	1·610	1·729	+0·04
ν Argûs	6 30 6·87	51·94	1·8335	1·8344	+0·001	42 59 30·7	52·2	2·629	2·795	+0·04
τ Argûs	6 43 43·77	51·98	1·4861	1·4861	+0·003	50 19 42·9	52·2	3·806	3·938	−0·04
α Pictoris	6 45 37·61	51·97	0·6368	0·6330	−0·018	61 40 40·5	52·2	3·969	4·025	+ 0·30
π Argûs	7 8 19·04	51·97	+2·1179	+2·1187	−0·001	−36 39 47·7	52·2	−5·893	−6·075	+0·01

Star's Name.	Mean R.A. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in R.A.	Mean Dec. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in Dec.
	h m s		s	s	s	° ′ ″		″	″	″
δ Volantis	7 16 53·14	52·02	+0·0204	+0·0056	−0·004	−67 29 57·6	52·3	−6·606	−6·612	+0·01
σ Argûs	7 21 18·40	51·98	1·9078	1·9082	−0·009	42 48 30·5	52·2	6·970	7·130	+0·20
α Puppis	7 43 37·67	52·06	2·0621	2·0618	−0·001	39 56 39·4	52·2	8·767	8·934	+0·01
ζ Argûs	7 54 48·12	52·06	2·1090	2·1098	−0·003	39 18 44·0	51·3	9·636	9·802	+0·02
γ Argûs	8 1 49·91	52·03	1·8499	1·8500	−0·002	46 36 40·8	52·2	10·171	10·314	+0·01
ε Argûs	8 17 21·38	52·06	+1·2521	+1·2467	−0·002	58 42 52·2	52·2	11·318	11·409	+0·08
α Chamæleontis	8 24 34·27	52·09	−1·3021	−1·3873	+0·020	76 7 12·7	52·3	11·834	11·732	+0·11
ο Argûs	8 33 7·38	52·03	+1·7236	+1·7231	0·000	52 2 36·9	52·2	12·431	12·551	+0·02
δ Argûs	8 37 48·18	52·09	1·6584	1·6573	−0·002	53 48 8·3	52·3	12·750	12·863	−0·07
α Volantis	8 58 26·83	52·09	0·9896	0·9768	−0·006	65 24 10·2	52·3	14·092	14·152	−0·09
λ Argûs	8 58 48·54	52·03	2·2005	2·2032	0·000	42 26 9·2	52·3	14·114	14·254	+0·06
G Carinæ	9 4 19·77	52·12	0·2811	0·2451	−0·018	71 35 49·1	52·3	14·454	14·466	−0·02
β Argûs	9 10 20·94	52·08	0·7574	0·7364	−0·031	68 41 25·5	52·3	14·815	14·857	+0·10
ι Argûs	9 10 23·84	52·12	1·6130	1·6117	−0·005	58 14 8·8	52·4	14·817	14·913	+0·06
κ Argûs	9 14 23·31	52·09	+1·8543	+1·8558	−0·005	53 57 7·6	52·2	15·051	15·158	+0·03
ζ Octantis	9 28 9 32	52·12	−5·6728	−6·4616	−0·104	84 37 26·1	52·3	15·820	15·469	+0·03
υ Argûs	9 40 50·80	52·06	+1·5106	+1·5078	−0·006	63 55 6·6	52·4	16·479	16·553	+0·02
φ Argûs	9 48 7·13	52·09	2·0901	2·0956	−0·004	53 23 14·6	52·3	16·833	16·933	+0·06
ω Argûs	10 7 46·87	52·09	1·4478	1·4447	−0·012	68 48 5·6	52·3	17·708	17·764	+0·02
I Carinæ	10 19 22·00	52·12	+1·2359	+1·2245	−0·003	−72 45 46·5	52·3	−18·162	−18·205	−0·02

Star's Name.	Mean R.A. 1750.0	Epoch 1700+.	Annual Precession 1750.0	Annual Precession 1812.5.	Proper Motion in R.A.	Mean Dec. 1750.0	Epoch 1700+.	Annual Precession 1750.0	Annual Precession 1812.5.	Proper Motion in Dec.
	h m s		s	s	s	° ′ ″		″	″	″
p Carinæ	10 23 11.76	52.09	+2.1044	+2.1141	−0.007	−60 24 22.4	52.3	−18.302	−18.375	+0.04
θ Argûs	10 34 6.05	52.15	2.1050	2.1166	−0.004	63 5 24.5	52.2	18.672	18.737	+0.02
η Argûs	10 35 25.72	52.09	2.2863	2.2992	−0.001	58 22 39.6	52.3	18.715	18.784	+0.06
μ Argûs	10 36 4.51	52.15	2.5360	2.5474	+0.007	48 6 24.0	52.3	18.735	18.812	−0.01
δ² Chamæleontis	10 43 11.65	52.15	0.7587	0.7089	−0.039	79 13 21.6	52.3	18.949	18.966	0.00
η Octantis	11 0 15.98	52.12	0.1586	0.0072	−0.070	83 14 49.7	52.4	19.387	19.383	−0.04
Lacaille 4779	11 20 45	...	...	...	...	30 28 35.5	51.7	19.772	19.811	+0.05
λ Centauri	11 24 23.10	52.09	2.6863	2.7125	−0.005	61 38 21.1	52.1	19.824	19.855	+0.01
π¹ Chamæleontis	11 27 9.91	52.15	2.3805	2.4188	−0.040	74 30 49.8	52.4	19.860	19.884	−0.02
ε Chamæleontis	11 47 37.45	52.33	2.7614	2.8284	−0.034	76 49 43.5	51.5	20.035	20.043	−0.03
κ Chamæleontis	11 52 16.02	52.26	2.8999	2.9656	−0.053	75 7 46.4	52.4	20.054	20.056	+0.04
λ Chamæleontis	11 55 2.33	52.26	2.9691	3.0329	−0.040	73 58 35.5	52.4	20.060	20.060	+0.04
δ Centauri	11 55 31.04	52.12	3.0394	3.0621	−0.004	49 19 45.8	51.9	20.061	20.060	0.00
ρ Centauri	11 58 42.94	52.26	3.0607	3.0849	−0.007	50 58 35.3	52.4	20.065	20.059	+0.02
δ Crucis	12 2 2.19	52.31	3.0885	3.1196	−0.007	57 21 30.6	52.3	20.064	20.055	+0.04
β Chamæleontis	12 4 16.77	52.29	3.1866	3.2864	−0.034	77 55 18.5	52.4	20.061	20.049	0.00
ε Crucis	12 8 2.81	52.29	3.1481	3.1828	−0.024	59 1 13.4	52.4	20.053	20.036	+0.17
α¹ Crucis	12 12 55.28	52.29	3.2100	3.2500	−0.015	61 42 47.5	52.3	20.033	20.010	+0.06
γ Crucis	12 17 27.59	52.29	3.2192	3.2514	+0.005	55 42 45.3	52.3	20.007	19.977	−0.20
γ Muscæ	12 17 54.18	52.31	+3.3689	+3.4359	−0.016	−70 44 53.7	52.3	−20.004	−19.972	−0.01

Star's Name.	Mean R.A. 1750·0. h m s	Epoch 1700+.	Annual Precession 1750·0. s	Annual Precession 1812·5. s	Proper Motion in R.A. s	Mean Dec. 1750·0. ° ′ ″	Epoch 1700+.	Annual Precession 1750·0. ″	Annual Precession 1812·5. ″	Proper Motion in Dec. ″
α Muscæ	12 22 34·65	52·31	+3·3915	+3·4498	−0·006	−67 45 15·7	52·4	−19·969	−19·929	0·00
γ Centauri	12 27 51·40	52·15	3·2474	3·2724	−0·020	47 34 58·8	51·5	19·917	19·874	0·00
β Muscæ	12 31 15·27	52·31	3·4929	3·5510	−0·008	66 44 5·8	52·3	19·879	19·828	0·00
β Crucis	12 33 18·28	52·29	3·3837	3·4211	−0·001	58 19 8·5	52·4	19·854	19·803	+0·05
δ Muscæ	12 45 29·45	52·31	3·8023	3·8816	+0·061	70 11 37·0	52·4	19·671	19·594	0·00
ι Centauri	13 6 37·99	51·40	3·3423	3·3606	−0·028	35 23 9·7	51·9	19·223	19·129	−0·06
ε Centauri	13 24 14·18	51·41	3·6892	3·7247	−0·007	52 11 1·3	51·5	18·725	18·596	−0·01
ν Centauri	13 34 37·82	52·26	3·5273	3·5503	−0·006	40 25 52·0	51·5	18·379	18·242	+0·03
μ Centauri	13 34 40·33	52·31	3·5403	3·5640	−0·001	41 13 3·0	51·5	18·378	18·240	+0·03
g Centauri	13 35 3·11	52·26	3·4225	3·4404	−0·004	33 11 29·2	52·5	18·364	18·231	−0·03
k Centauri	13 37 29·62	52·24	3·4114	3·4285	−0·010	31 44 34·8	52·5	18·276	18·141	0·00
ζ Centauri	13 40 5·20	51·41	3·6567	3·6852	−0·006	46 2 44·3	51·5	18·182	18·034	0·00
β Centauri	13 46 26·97	52·24	4·0731	4·1239	−0·009	59 9 2·2	52·5	17·940	17·764	−0·03
δ Octantis	13 50 1·14	52·31	7·7539	8·2939	−0·089	82 29 12·2	52·3	17·797	17·443	0·00
θ Centauri	13 52 3·99	51·41	3·5120	3·5314	−0·045	35 7 37·2	51·6	17·714	17·556	−0·50
ι Lupi	14 3 31·53	52·29	3·7539	3·7817	+0·003	44 53 33·6	51·5	17·220	17·037	+0·13
η Centauri	14 19 44·79	51·40	3·7368	3·7608	−0·002	41 2 34·3	51·5	16·449	16·247	−0·01
α Circini	14 22 39·07	51·41	4·6593	4·7272	−0·033	63 51 47·9	52·5	16·302	16·045	−0·24
α¹ Centauri	14 22 48·26	51·41	4·4103	4·4643	−0·482	59 47 26·1	52·5	16·295	16·052	+0·82
α² Centauri	14 22 49·97	51·41	+4·4106	+4·4644	−0·482	−59 47 9·9	52·5	−16·293	−16·050	+0·82

Star's Name.	Mean R.A. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in R.A.	Mean Dec. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in Dec.
	h m s		s	s	s	° ′ ″		″	″	″
α Lupi	14 25 27·26	51·40	+3·8997	+3·9288	−0·007	−46 17 46·3	51·5	−16·158	−15·939	−0·01
β Lupi	14 42 16·56	51·41	3·8561	3·8805	−0·004	42 6 19·2	51·5	15·241	15·006	−0·07
κ Centauri	14 43 0·80	51·46	3·8311	3·8546	−0·002	41 4 50·3	51·5	15·200	14·965	−0·02
π Lupi	14 48 14·65	51·46	3·9996	4·0276	−0·009	46 3 4·0	51·5	14·897	14·645	−0·01
γ Trianguli Australis	14 56 0·32	51·41	5·3385	5·4246	−0·016	67 43 32·2	52·5	14·433	14·085	−0·02
δ Lupi	15 5 3·84	51·41	3·8729	3·8942	−0·002	39 43 13·8	51·5	13·872	13·609	0·00
ε Lupi	15 5 49·46	51·41	3·9987	4·0233	−0·002	43 46 0·9	51·6	13·822	13·552	−0·01
γ Lupi	15 18 34·58	51·41	3·9345	3·9553	0·000	40 18 9·5	51·5	12·993	12·713	−0·01
β Trianguli Australis	15 33 22·94	51·40	5·1424	5·1959	−0·029	62 37 34·6	52·5	11·978	11·594	−0·38
α Trianguli Australis	16 22 28·32	51·41	6·1665	6·2271	+0·002	68 31 24·5	52·5	8·283	7·764	−0·04
ε Scorpii	16 34 1·13	51·41	3·9035	3·9140	−0·050	33 48 41·1	52·1	7·353	7·018	−0·26
μ^1 Scorpii	16 34 59·60	51·46	4·0297	4·0415	−0·003	37 35 22·7	51·6	7·273	6·927	0·00
ζ^2 Scorpii	16 37 3·27	51·49	4·1924	4·2059	−0·013	41 54 5·7	51·6	7·104	6·744	−0·26
ζ Aræ	16 38 2·78	51·49	4·8973	4·9208	−0·012	55 33 36·4	52·1	7·023	6·600	−0·02
ϵ^1 Aræ	16 39 44·94	52·44	4·7218	4·7421	0·000	52 44 32·4	51·5	6·883	6·474	+0·05
η Scorpii	16 54 18·11	51·49	4·2613	4·2727	−0·001	42 52 44·6	51·6	5·673	5·299	−0·25
γ Aræ	17 4 25·58	51·49	5·0028	5·0196	−0·002	56 6 21·6	52·5	4·818	4·372	+0·04
β Aræ	17 4 35·22	51·49	4·9425	4·9587	−0·002	55 15 24·9	51·6	4·804	4·365	0·00
δ Aræ	17 8 36·91	51·49	+5·3690	+5·3886	−0·011	−60 26 4·6	52·5	−4·461	−3·981	−0·09

Star's Name.	Mean R.A. 1750.0. h m s	Epoch 1700+.	Annual Precession 1750.0. s	Annual Precession 1812.5. s	Proper Motion in R.A. s	Mean Dec. 1750.0. ° ′ ″	Epoch 1700+.	Annual Precession 1750.0. ″	Annual Precession 1812.5. ″	Proper Motion in Dec. ″
α Aræ	17 12 33.74	51.47	+4.6105	+4.6214	−0.004	−49 38 38.2	51.6	−4.123	−3.710	−0.03
υ Scorpii	17 13 47.91	51.52	4.0599	4.0667	−0.002	37 3 59.6	51.6	4.017	3.653	0.00
λ Scorpii	17 16 39.56	51.64	4.0561	4.0625	−0.001	36 53 32.2	51.6	3.772	3.406	+0.01
θ Scorpii	17 19 23.24	51.41	4.2896	4.2969	−0.001	42 48 28.8	51.6	3.537	3.151	+0.06
η Pavonis	17 21 16.51	51.49	5.8412	5.8603	−0.007	64 33 27.9	52.2	3.374	2.847	−0.10
κ Scorpii	17 25 13.17	51.49	4.1358	4.1414	−0.003	38 52 19.3	51.6	3.034	2.659	+0.05
ι¹ Scorpii	17 30 7.98	51.40	4.1827	4.1879	−0.007	39 59 54.4	51.5	2.607	2.227	0.00
γ¹ Sagittarii	17 49 3.68	51.52	3.8280	3.8296	−0.003	29 33 45.2	51.6	0.957	0.608	+0.02
γ² Sagittarii	17 49 45	...	...	...	...	30 23 53.5	51.6	−0.897	−0.546	−0.17
η Sagittarii	18 0 42.86	51.41	4.0709	4.0713	−0.013	36 48 25.8	51.6	+0.063	+0.433	−0.13
δ Sagittarii	18 4 58	...	...	...	...	29 54 18.0	51.6	0.435	0.785	−0.03
ε Sagittarii	18 7 34.91	51.41	3.9878	3.9875	−0.007	34 28 19.6	52.2	0.664	1.027	−0.13
α Telescopii	18 8 25.66	51.55	4.4577	4.4563	−0.004	46 4 21.8	51.7	0.738	1.145	−0.04
ζ Pavonis	18 13 43.08	52.44	7.0812	7.0653	−0.007	71 35 18.7	51.7	1.200	1.843	−0.18
ζ Sagittarii	18 46 41	...	...	...	...	30 12 35.6	51.6	4.059	4.399	+0.02
β¹ Sagittarii	19 4 36.57	51.59	4.3501	4.3389	0.000	44 53 48.3	51.7	5.582	5.962	−0.04
β² Sagittarii	19 5 5.92	51.59	4.3647	4.3533	+0.007	45 14 18.8	51.7	5.623	6.002	−0.06
α Sagittarii	19 6 30.83	51.59	4.1864	4.1766	+0.004	41 3 26.3	51.7	5.742	6.104	−0.09
ε Pavonis	19 31 11.41	51.55	+7.2393	+7.1435	+0.013	−73 31 24.1	51.7	+7.775	+8.372	−0.11

Star's Name.	Mean R.A. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in R.A.	Mean Dec. 1750·0.	Epoch 1700+.	Annual Precession 1750·0.	Annual Precession 1812·5.	Proper Motion in Dec.
	h m s		s	s	s	° ′ ″		″	″	″
δ Pavonis	19 43 55·62	51·55	+5·8729	+5·8152	+0·195	−66 46 49·1	51·7	+8·789	+9·264	−1·13
α Pavonis	20 5 41·37	51·55	4·8622	4·8258	+0·002	57 30 26	...	...	...	...
α Indi	20 19 51·79	51·59	4·2932	4·2687	+0·005	48 8 21·3	51·7	11·499	11·815	+0·11
β Pavonis	20 22 4·54	51·59	5·6434	5·5712	−0·006	67 4 7·3	52·0	11·654	12·067	0·00
β Indi	20 35 3·43	51·59	4·8316	4·7858	−0·001	59 22 19·6	51·8	12·563	12·899	+0·02
γ Pavonis	21 5 24·49	51·55	5·1905	5·1134	+0·010	66 28 17·4	52·2	14·519	14·835	+0·78
ν Octantis	21 12 31	...	...	...	...	78 28 1·1	51·8	14·942	15·375	−0·26
γ Gruis	21 38 42·41	51·55	3·6857	3·6659	+0·005	38 31 31·7	51·8	16·371	16·558	−0·02
α Gruis	21 52 20·60	51·59	3·8597	3·8303	+0·010	48 9 29·1	51·8	17·032	17·210	−0·13
α Toucani	22 1 7·13	51·59	4·2917	4·2354	−0·011	61 29 35·2	52·0	17·426	17·610	+0·01
β Octantis	22 18 34·92	51·75	7·5251	7·0361	−0·056	82 40 24·5	52·3	18·132	18 404	−0·03
β Gruis	22 27 36·53	51·59	3·6565	3·6282	+0·013	48 10 58·4	51·8	18·457	18·580	+0·01
τ Octantis	22 30 25	...	...	...	...	88 49 56·8	52·2	18·552	...	−0·02
α Piscis Australis	22 43 46	...	...	...	...	30 56 24·2	51 8	18·965	19·057	−0·17
γ Toucani	23 2 39·09	51·73	+3·6345	+3·5920	−0·007	59 36 0·8	52·1	19·440	19·514	+0·06
γ^1 Octantis	23 36 35	...	...	...	...	−83 24 27·2	52·5	+19·960	+19·990	0·00

Blackheath :
May 10, 1888.

F F

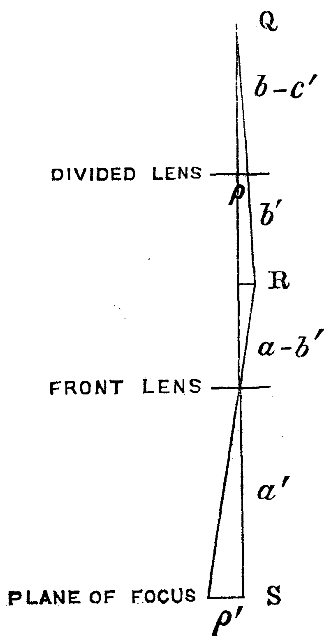
On the Condition that in a Double-Image Micrometer the value of a Revolution of the Micrometer Screw be independent of the Accommodation of the Eye. By Professor J. A. C. Oudemans.

Putting the focal lengths of the lenses of the micrometer (beginning from the object-glass), p, q, r, s; the intervals between the lenses (in the same order), a, b, c; then the proportions pointed out by Valz, adopted by Sir G. Airy, and by the constructors, Messrs. Troughton and Simms, are (*Monthly Notices*, vol. x. p. 161):

Focal length of	front lens	$=p=$ arbitrary,*	
,,	divided lens	$=q=-1$,	
,,	field-glass	$=r=+1$,	
,,	eye-glass	$=s=+1$,	
Interval between	front and divided lens		$a=p$,
,,	divided lens and field-glass		$b=1$,
,,	field-glass and eye-glass		$c=3$.

Supposing the eye to be hypermetropic, so that it accommodates for rays converging to a point lying behind the eye-glass at a distance D, then, if we follow the rays of light from the eye to the focus of the micrometer, these rays, after passing each lens, will intersect the axis successively in four points, P, Q, R, S; if we put the distances of these points beyond the lastly passed lens, $=D'$, c', b', and a', these values all depend on D.

Let ρ be the distance between two successive turns of the micrometer screw, and ρ' the corresponding quantity in the measured object, we have



$$\frac{\rho'}{\rho}=\frac{a'}{a-b'}\left(1+\frac{b'}{b-c'}\right)$$

or, putting $b-c'=e$,

$$\frac{\rho'}{\rho}=\frac{a'}{a-b'}\left(1+\frac{b'}{e}\right);$$

but

$$b'=\frac{eq}{e-q},$$

thus

$$1+\frac{b'}{e}=\frac{e}{e-q}=\frac{1}{1-\frac{q}{e}},$$

$$a'=\frac{(a-b')p}{a-b'-p} \qquad \frac{a'}{a-b'}=\frac{p}{a-b'-p}$$

$$\frac{\rho'}{\rho}=\frac{p}{a-\frac{eq}{e-q}-p}\cdot\frac{1}{1-\frac{q}{e}}=\frac{p}{(a-p)\left(1-\frac{q}{e}\right)-q}.$$

* In the micrometer, constructed by Messrs. Troughton and Simms for the Leyden Observatory, in 1855, there are four front lenses, giving four magnifying powers, and having a focal length of 1, $\frac{3}{4}$, $\frac{1}{2}$, and $\frac{1}{3}$. The inch seems to have been taken as unity.